

ADVANCED INFORMATIONAL INFRASTRUCTURE FOR MEDICAL ORGANIZATION

This work focuses on the use of information systems in Belarusian medical institutions to improve healthcare services. It identifies challenges in utilizing these systems, analyzes user requirements, and proposes a novel information system with various modules. The study employs modern methods, drawing from global healthcare experiences. Key software tools used include Microsoft SQL Server and Windows Forms. The database's main goal is to manage patient, doctor, and medical service information, offering functionalities like updating, deleting, adding, and searching data. The work presents data models, use-case diagrams, and Transact-SQL queries. The developed system supports data sorting, filtering, and visualization, aiding informed decision-making and improving medical service quality. Future plans include enhancing the user interface for increased efficiency and productivity.

Keywords: *Healthcare Information Systems, Digitalization, Belarus, Database Management, Transact-SQL, Data Analysis*

In today's era of digitalization, information technologies are pivotal across various sectors, including the healthcare industry. Over recent decades, Belarus's medical institutions have fervently adopted a myriad of information systems, aiming to elevate the quality and efficacy of healthcare services delivered to its citizens.

The work aims to study the main problems and difficulties encountered in utilizing information systems within Belarus's medical establishments. It also seeks to discern the essential requirements of users in the context of information system utilization. An analysis of the prevailing solutions will lead to the formulation of a concept for a novel information system. This system will comprise modules dedicated to patient interactions, medical services, professional consultations, laboratory examinations, collaborations with insurance entities, and various other essential medical operational sectors.

To carry out this research, an approach based on modern methods of analysis and design of information systems will be used, as well as the experience of application of such systems in diverse global healthcare settings [1, p. 47]. The culmination of this research, coupled with the inception of a novel information system, is anticipated to markedly amplify operational efficiencies within Belarusian medical facilities, and enhance the caliber of healthcare outcomes for the populace.

In creating our information system, we used the following software tools: Microsoft SQL Server DBMS, Windows Forms for the client-side of the application.

The main goal of our database for the medical information system is to obtain information about patients, doctors, and provided medical services [2, p. 108]. In addition, it should provide the ability to update, delete, add, and search for necessary information.

The medical system's database will store the following information:

- Patient information;
- Doctor information;
- Medical service information;
- Patient medical history information;
- Appointment scheduling information;
- Medical institution information.

Thus, based on the listed information, the database will have the following tables: "Patients", "Doctors", "Medical Services", "Medical History", "Appointments", and "Hospitals".

Figure 1 presents the result of the data modeling of the database.

Figure 2 presents use-case diagram of this model.

For creating and working with the database, we used the Transact-SQL language, as it provides efficient tools for processing and managing data, facilitating the execution of complex queries and allowing flexible adjustment of database parameters according to project requirements [3, p. 182]. Using Transact-SQL, we created data tables, and then composed queries to fill them with the necessary values.



Fig. 1. Database model

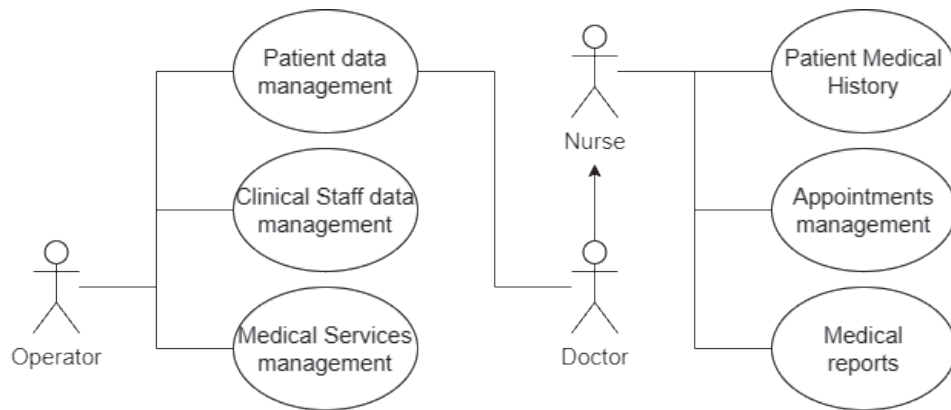


Fig. 2. Use-case diagram

Results		Messages		
	id	service_name	description	cost
1	1	General Checkup	A comprehensive checkup with a doctor	50.00
2	2	Blood Test	A complete blood count and analysis	30.00
3	3	MRI Scan	Magnetic resonance imaging for diagnostics	150.00
4	4	X-Ray	Radiography for bone and tissue imaging	60.00
5	5	ECG	Electrocardiogram for heart health assessment	40.00
6	6	Vaccination	Immunization against various diseases	25.00
7	7	Physical Therapy	Rehabilitation and pain management	70.00
8	8	Dental Cleaning	Oral hygiene and plaque removal	45.00
9	9	Ultrasound	Diagnostic imaging using sound waves	80.00
10	10	Orthopedic Consultation	Evaluation and treatment of musculoskeletal issues	55.00
11	11	Dermatology Consultation	Skin health assessment and treatment	60.00
12	12	Gastroenterology Consultation	Digestive system evaluation and treatment	65.00
13	13	Cardiology Consultation	Heart health evaluation and treatment	70.00
14	14	Neurology Consultation	Nervous system evaluation and treatment	75.00
15	15	Psychiatry Consultation	Mental health evaluation and treatment	80.00

Fig. 3. Result of filling the MedicalServices table

To provide additional convenience, we developed several queries. One example query is shown in Figure 4 and demonstrates information related to the patient’s medical history.

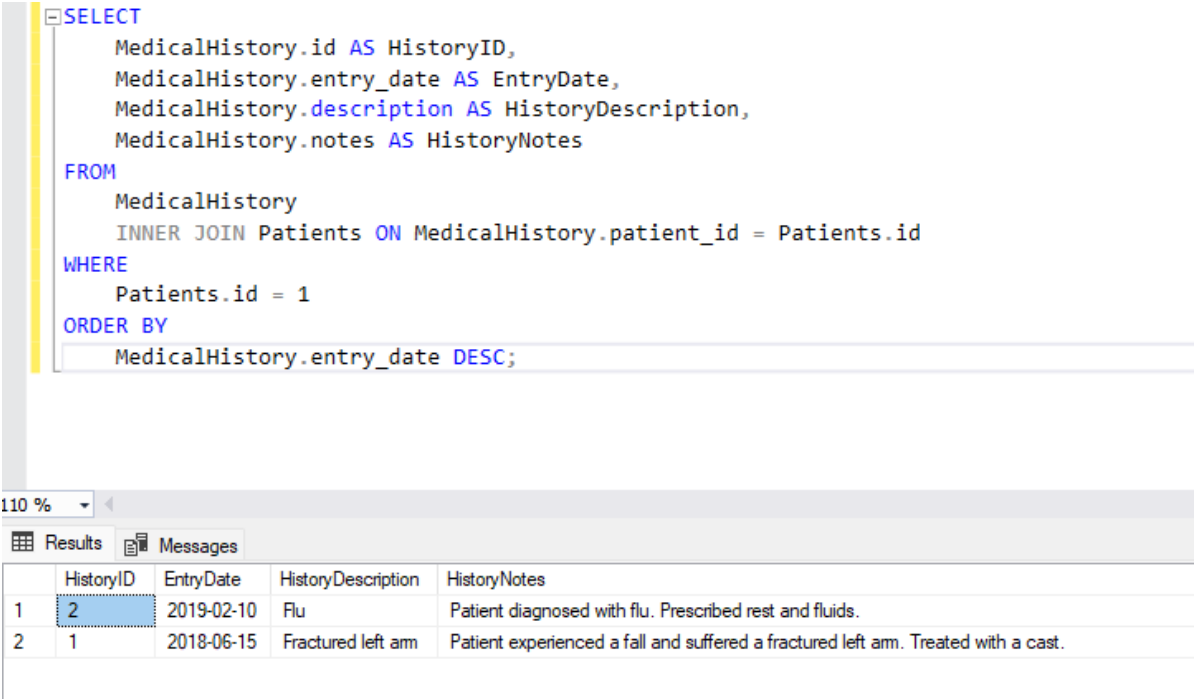


Fig. 4. Result of creating and executing the query

The medical information system we developed offers capabilities for performing various operations, such as sorting data by different categories, extracting up-to-date information about patients, doctors, and medical services, as well as visually presenting results using charts and tables for user convenience. Additionally, the system supports data filtering based on specified criteria, allowing medical staff to easily track patients’ condition dynamics, identify the most in-demand medical services, and analyze doctors’ workload. This facilitates informed decision-making, improves coordination between departments, and contributes to enhancing the quality of medical services [5, p. 105].

The final stage of this work involves creating a user interface based on Windows Forms. This tool has allowed for the development of a practical and intuitively understandable interface, which provides convenient access to the database functions and enhances its utilization efficiency [6, p. 42].

The “Hospitals” form is shown in Figure 5, it contains information about medical institutions and the doctors working there.

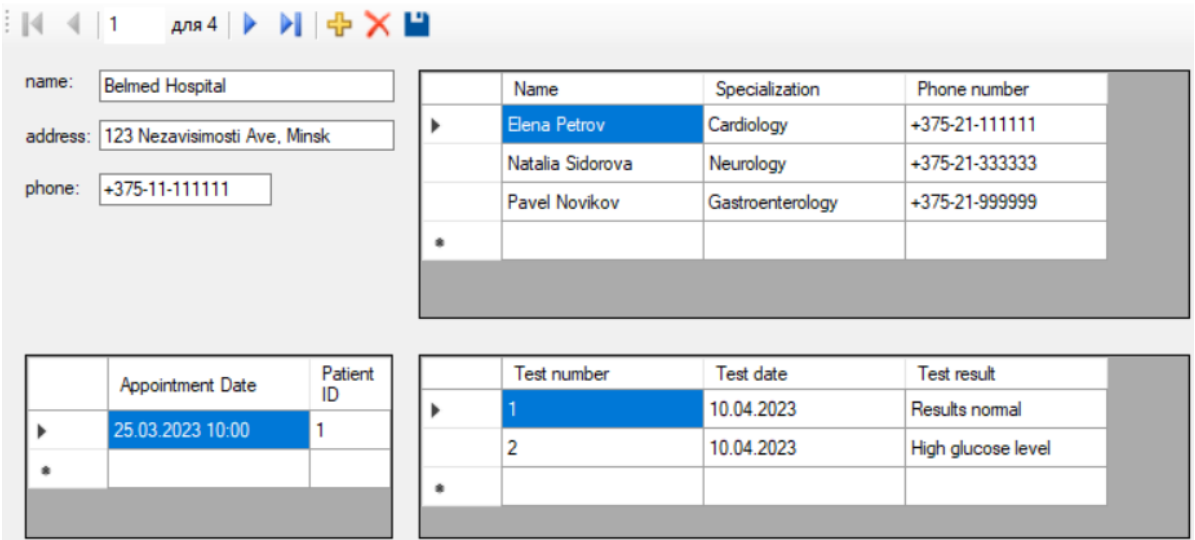


Fig. 5. Hospitals form

The “Patient” form is shown in Figure 6, it contains information about patients.

The screenshot displays a software interface for a patient form. At the top, there is a header bar with navigation icons and a label '1 для 14'. Below this, the form is divided into several sections:

- Patient List Table:** A table with columns: Name, Birth date, Address, and Phone number. It lists several patients, with 'Ivan Morozov' highlighted in blue.
- Appointment Details Table:** A table with columns: Service ID and Appointment date. It shows '1' for Service ID and '25.03.2023 10:00' for Appointment date.
- Test Results Table:** A table with columns: Test date and Test results. It shows '10.04.2023' for Test date and 'Results normal' for Test results.
- Notes Table:** A table with columns: Entry date, Description, and Notes. It shows '10.04.2023' for Entry date, 'Patient complained of fatigue' for Description, and 'Prescribed rest and hydration' for Notes.

Fig. 6. Patient form

Future plans include developing a modern and ergonomic user interface that will simplify working with the system, making it more intuitive and convenient for medical institution staff. This will also reduce the time required for personnel training and increase work productivity.

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